MASTER OF SCIENCE
IN
AERONAUTICAL ENGINEERING

DEVELOPMENT OF A SIX-DEGREE-OF-FREEDOM MODEL FOR A FULLY DEPLOYED G-12 AGAS DELIVERY SYSTEM

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Guiding an airdrop delivery system to intended target points of touchdown using low cost flat circular parachutes has become an important goal over the past five years. The development of this six-degree-of-freedom model extends ongoing research in predicting the parachute's dynamic behavior and ballistic trajectory under the influence of wind disturbances. Previous models based on three degrees of freedom have proven acceptable in predicting the G-12 delivery system's trajectory, but did not capture the coning motion associated with parachute systems. This thesis focused on the development of a six-degree-of-freedom (6-DOF) model for a rigid-body system and studied if a higher fidelity model could provide increased delivery accuracy. The model, developed in SIMULINK ™, used state-space relationships for the equations of motion and incorporated the effects of the air mass that surrounds the parachute system throughout its descent. Compared to the limited drop data available, the 6-DOF model produced trajectory results similar to those achieved with the low-fidelity 3-DOF model while additionally capturing the basic dynamic behavior and coning motion. Continued modeling of aerodynamic coefficients and the apparent mass tensor using parameter estimation techniques, however, is recommended to improve the model's ability to accurately predict the dynamic motion and trajectory of the G-12.

KEYWORDS: G-12 Parachute, Six-Degree-of-Freedom, 6DOF, Modeling, G-12 Affordable Guided Airdrop System, AGAS, SIMULINK